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for the health sciences

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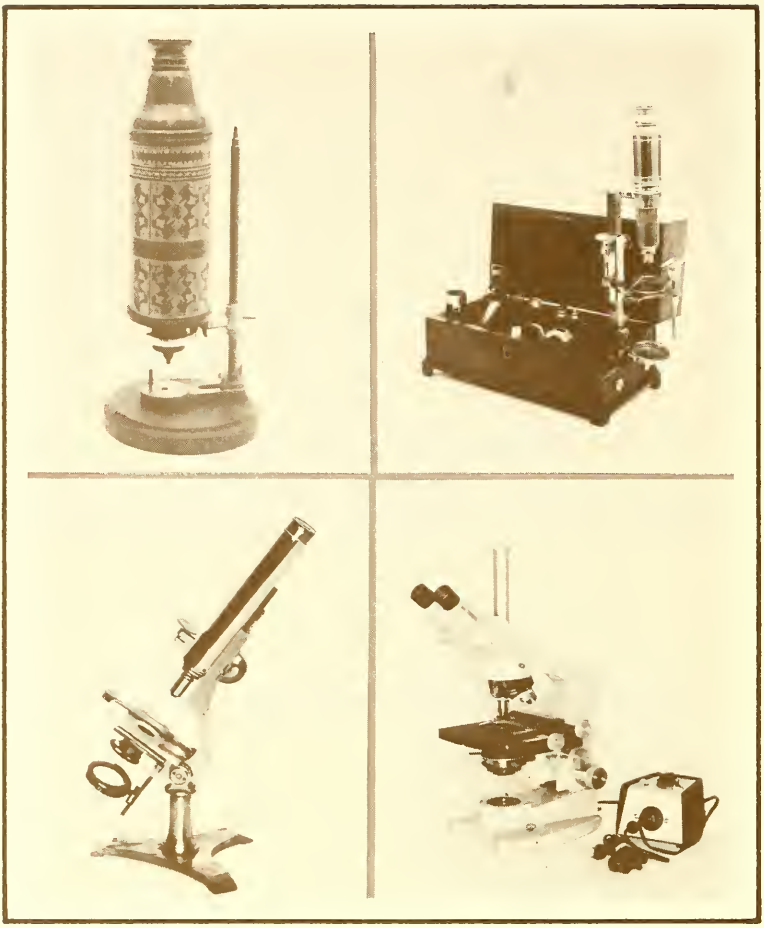
Microscopy and The Army Medical Museum

by Adrianne Nöe and George S.M. Cowan



Microscopes in the Billings Collection vary by size, age, manufacture, material, use, origin, and, of course, by type. Four from the collection are represented in this photograph. In the upper left is the "Hooke" compound monocular microscope, dating to about 1665. Probably manufactured by Christopher Cock in London, it is similar to the instrument pictured in Micrographia. *John Shaw Billings purchased it through John Mayall. At the upper right is an English microscope and accessory chest, ca. 1760. It too is a compound monocular instrument and was acquired as part of the Kaas Collection. In the lower left is another compound monocular microscope, ca. 1862. Produced by the Philadelphia instrument maker Joseph Zentmayer, it is typical of the microscopes of the day and was introduced during the Civil War for use by United States Army hospital staff. The remaining microscope is a product of the American Optical Company in Buffalo, New York, ca. 1961. As a compound trinocular, it can be assembled into various configurations and is typical of benchtop instruments throughout the 1960s. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-7153.)*

Microscopy and The Army Medical Museum

by Adrianne Nöe and George S.M. Cowan

The Armed Forces Medical Museum shares much in common with the health science and medical history museums of the nation. Its collections are artifactual and documentary evidence of the vitality of medical thought and the broad sphere of its influence. The staff grapples with decisions affecting the presentation of this material in ways both useful to the professional community and interesting to its lay visitors. In significant respects, though, the Armed Forces Medical Museum occupies a unique position among the list of institutions offering perspectives in medical history. It is among the oldest and largest medical collections in the country. Its advisors and contributors form a coterie occupying some of the most significant roles in the last one hundred twenty-four years in American military medicine. It safeguards hundreds of thousands of objects in that field—documents, photographs, anatomical and pathological collections, grand historical artifacts and the more anonymous items which might otherwise escape notice but are nonetheless proof of careers devoted to the advance of modern medicine. These objects afford the organization a special place among museums in general and medical museums in particular.

The Billings Microscope Collection is one of the oldest and largest groups of objects in the holdings. The nearly nine hundred instruments in it are useful tools for documenting aspects of the history of science, medicine and technology. The story of these instruments is key to understanding much of the museum which houses them. Significantly, the Army Medical Museum, as the Armed Forces Medical Museum was then called, was initially formed shortly after microscopes had begun to make their indelible impression on medicine. It is not the intent of the authors to offer an evolutionary chronology of the microscope. Nor do we present a technical history of the mechanics or optics of the microscope. All have been done elsewhere and in other times.[1]

Rather, in this essay we present a view of the Armed Forces Medical Museum highlighting the formative effects of this best known collection.

The organizations now known as the Armed Forces Institute of Pathology and the National Library of Medicine were once a single entity—the Army Medical Museum. Many events have intervened in the history of this Army Medical Museum since its inception in 1862 by order of Surgeon General William Hammond (1828-1900). An accomplished physician and experimenter, Hammond instigated wide medical reforms within the Army, such as requiring written records of treatments, requiring standardized examinations to select Medical Corps members and establishing the Army Medical Museum.

The events which characterize the first years of the museum are significant. In part to allay the vitriolic "allopathic versus homeopathic" arguments of the early 1860s, Hammond insisted upon a most empirical study—a multivolume exposition: *The Medical and Surgical History of the War of the Rebellion.*[2] In the process of compiling statistics for this analysis of Civil War medicine, a museum was begun. As medical officers in hospitals and in the field performed their duties and compiled necessary reports of their various sanitary, surgical and medical activities, Hammond instructed them to collect teaching specimens of morbid anatomy along with associated foreign bodies and to forward them, accompanied by appropriate notes, to Washington. After Hammond placed Brigade Surgeon John Hill Brinton (1832-1907) in charge of the surgical section of the series, Brinton eventually assumed the role of Curator for incoming specimens, actively soliciting their donation. Convinced of a medical museum's teaching potential, he traveled to various battle sites, collecting specimens of disease and injury for the museum and successfully encouraging participation from medical officers. Eventually he established an official standardized channel for donation of an increasing wealth of specimens.

By the time of its publication in January of 1863, the Catalogue of the Army Medical Museum listed almost 1,000 items. When the collection was two years old, it had grown to occupy its third formal location in Washington and numbered over 3,500 specimens. By the end of the Civil War, its size had doubled. Eventual political pressures on the medical service in Washington resulted in the

INSTRUCTIONS FOR MEDICAL OFFICERS TO WHOM A MICROSCOPE IS FURNISHED.

WAR DEPARTMENT,

Surgeon General's Office,

WASHINGTON, *July* 1, 1868.

Medical Officers to whom microscopes are issued from this Office, will be expected to collect material for the Microscopical Section of the Army Medical Museum.

They are not required to contribute mounted slides, although well prepared slides will always be acceptable, and duly credited, but are expected to collect so far as they are able such materials as may prove valuable to the Museum.

Pathological growths of all kinds, whether external or internal, in man or in animals, are especially desired at the Museum for study.

The books describe so many different methods of investigating such growths, that it has been thought advisable to acquaint Medical Officers with the mode found most advantageous at the Museum in preparing specimens for preservation.

The growth having been removed by an operation, or obtained at an autopsy, is to be immediately examined, and its appearance, color, consistence and anatomical relations recorded. Several small portions from the edges, centre, etc., of the growth are to be removed for the purpose of affording thin sections. The cut surface is then scraped, and the juice, diluted if necessary with blood-serum, or a solution of albumen of about the same specific gravity, is examined microscopically. The appearance of the elements thus observed should be recorded by making a camera lucida drawing.

The growth is now to be placed in proof spirit for transmission to the Army Medical Museum. One set of the small portions should also be sent in properly labeled phials of proof spirit to the Museum. A duplicate set should be retained in similar phials for study.

Broadside instructing medical officers to contribute specimens to the Army Medical Museum, 1868. The Surgeon General distributed a pamphlet, which included this order, throughout the Army. This object is in the collection of the Otis Historical Archives of the Armed Forces Medical Museum. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology, Washington, D.C., 20306-6000. Negative Number 86-6648.)

appointment of a new Surgeon General and subsequently, a new individual in the role of Curator—Colonel George A. Otis (1830-1881). By the time Otis retired in 1881, he had overseen the expansion of the museum's existing surgical and photographic sections and had accessioned the first microscopes as museum objects.

Lieutenant Colonel Joseph J. Woodward (1833-1884) had been with the museum since its genesis. He authored the medical sections of Hammond's history of the War of the Rebellion and headed a growing pathology collection, which included numerous mounted microscopic sections. A pioneering pathologist in the use of dyes and novel tissue staining techniques, Woodward was no stranger to the microscope or various mechanical aids to the study of pathology. Woodward's photomicrographic work, begun in 1864, required numerous ingenious devices of his own and his assistants' design. Although their tasks were numerous, Woodward and his staff persisted in pioneering many photomicrographic endeavors. Eventually, they produced hundreds of negative images using various light sources such as illuminators and heliostats and the museum's growing collection of contemporary microscopes—particularly models from American manufacturers.

Even with the military's shrinking coffers at the end of the Civil War, the museum continued to amass pathology specimens and the goodwill, if not generous financial assistance, of the Surgeon General's office. In 1866, and for two decades following, the museum occupied its fourth location in Washington—Ford's Theater. While at that site, the museum hosted thousands of visitors: foreign and local, military and civilian dignitaries and an interested public, medical professionals and a curious lay audience. These individuals came to see medical, surgical and microscopical specimens, wax anatomy models, artists' renderings of diseased patients, comparative anatomy collections, hundreds of plaster casts, and thousands of human bones and crania and other specimens. Contributions to this growing museum came from physicians in all parts of the country who were anxious to express their interest and support for this national medical endeavor. By this point in its history, the Army Medical Museum had one of the largest medical collections in the world and had come to welcome specimens and students of all diseases and injuries, not just those related to the battlefield.

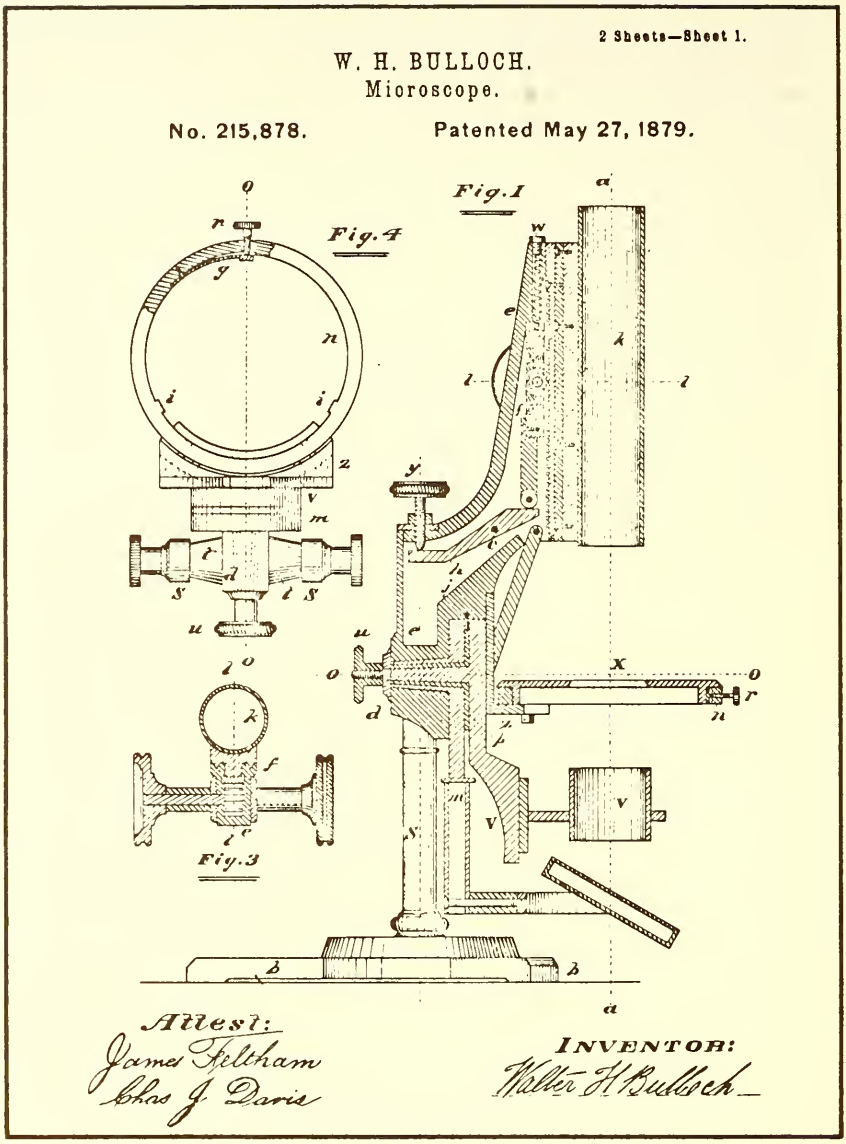
The museum building itself, as one historian has noted, played host to Washington's intellectual and scientific communities of the 1870s.[3] The National Academy of Sciences and the American Medical Association were among the prestigious societies meeting at the museum. Members of these groups had the opportunity to observe the collections, including Woodward's micrographs and the heliostats and microscopes necessary to produce them. Visitors to the museum formed a group well prepared to appreciate a tool as fascinating and of as timely an interest as the microscope.

The community did more than maintain an avid interest in arguments about the role of bacteria in disease. It actively followed the role of the microscope in investigating that issue and it supported the growth of the medical museum to further a great range of studies, including those topics highly dependent upon microscopy. That growth demanded not just new medical technology, but support for a new building in which it would be housed and used.

Concerned about an increasingly large collection in a finite amount of space, as well as the risk of fire and other unsafe conditions, national medical and scientific communities supported safeguarding the growing medical collection. From the early 1880s onward, the museum held more than specimens and miscellany. It also housed one of the largest medical libraries, comprising nearly 70,000 volumes. After significant political wrangling brought on by the lobbies of the American Medical Association and other organizations, and tortuous arguments of more than four years' duration, Congress authorized a new home for the Army Medical Museum in 1884. The new quarters were to house the collections, laboratories, offices, expanded exhibit areas, pension and medical records, and a national library of medicine.

The space problem solved, the museum occupied its fifth home early in 1888. The mall in Washington, D.C. was the museum's new location. In the intervening period a new curator assumed his first years in a role that would forever change the character of the medical museum. Late in 1883, Major John Shaw Billings (1838-1913) became Librarian and Curator of the Museum and Library Division of the Surgeon General's Office.

John Shaw Billings was as concerned with illuminating means of medical research as he was with interpreting and illustrating its



Patent drawing for a compound microscope in the Billings Collection of the Armed Forces Medical Museum. A large group of patent applications and related drawings are among supporting documents for the microscope collection in the Otis Historical Archives. As a group, they indicate a wide spread interest in invention and innovation from within both research and instrument manufacturing communities alike. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6645.)

results. Again, the medical community supported the museum's goals by contributing to the collections and continuing to visit the museum to view the anatomy and pathology specimens and other objects. Visitors during Billings' tenure could also learn of the museum's involvement in studying morphology and ethnological classification. They might have seen exhibits containing transportation models and medical supplies related to the work of various units in the Army medical department, or they might have observed a growing array of medical instruments, a display which highlighted the evolution of the microscope and its historical antecedents. The mere fact that Billings included an historical glimpse of the microscopes necessary to study the specimens points to his sensitivity to the scientific times in which he lived. For even as he began his active microscope collecting, the instrument was assuming an ever increasing role in medical study.

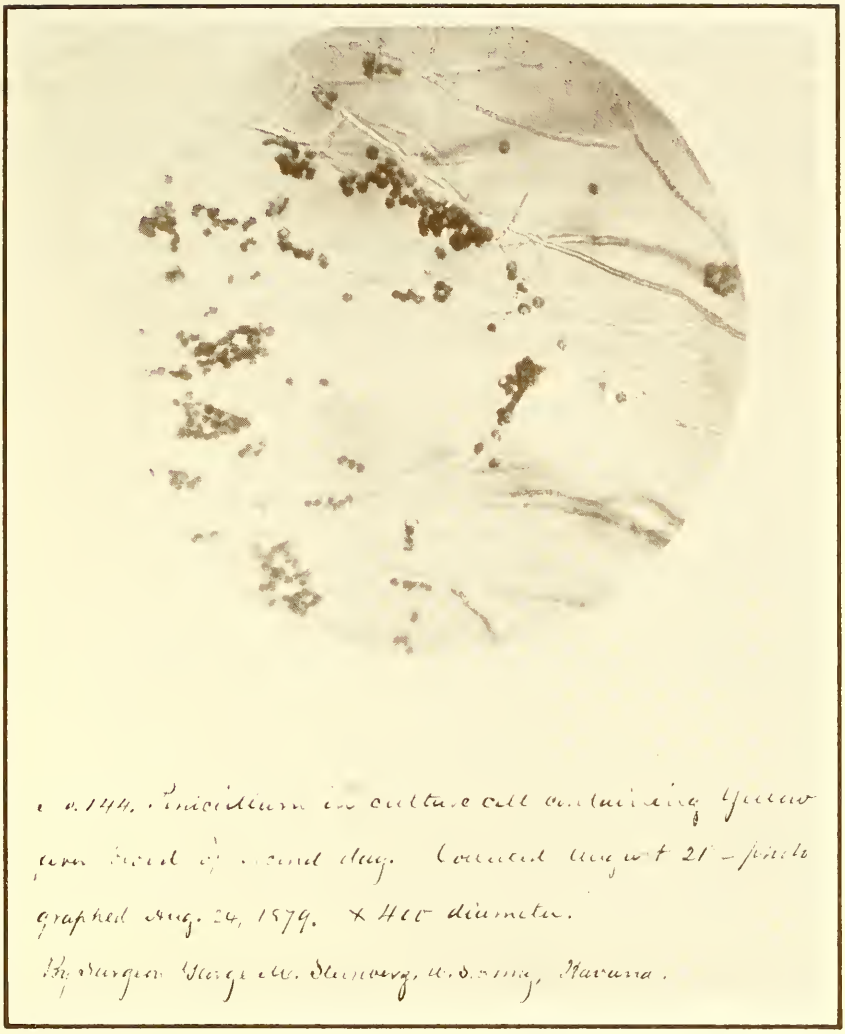
Billings was interested in all contributions to medicine. As a bibliographer as well as curator and collector, he had the inclination to incorporate this sensitivity to historic events into the contemporary museum. In addressing the Congress of American Physicians and Surgeons in Washington in 1888, Billings made the following pronouncement, reminiscent of James Smithson some half century earlier: "The objects of a medical museum are to preserve, to diffuse and to increase knowledge. Its conservative function is to form a permanent record of what has been demonstrated and to fix the meaning of terms.... To get useful results from the older literature we must know the precise significance of the old words."[4] In the case of the microscope collection, one may extend the significance of words to include that of microscopes.

In addition to a new building, an expanding collection, and a world class medical library, three events added to the reputation of the museum as a learning center. Early in the decade Billings established himself as the now well-known compiler of a subject index of medical articles in any periodical available to the library—the *Index Medicus*. The second event was also related to museum publications. *The Medical and Surgical History of the War of the Rebellion* was finished at last, and in it the museum had its magnum opus. Together with the *Index*, it brought international attention to the organization. Finally, out of the museum grew the new Army Medical School, which offered special instruction in military medicine and supplemented other medical education.

Housed at the museum and benefiting from its pathology collections and growing medical technologies, the school offered course work and practice in military surgery, tropical medicine, care and transportation of the wounded, examination of recruits, medical jurisprudence and military law. Its students and faculty could adopt the newest of medical implements. For example, as early as June of 1896, while x-ray research was in its infancy museum staff became one of the first groups to exploit the new science. Tubes used to locate foreign bodies buried deeply within wounds were but one of the many pioneering uses to which radiology was put. Through these events, the museum's reputation as a world center in military medical thought and practice was assured. Thus, the Army continued to attract to its service a number of men who would occupy the forefront of medical research for decades to come.

Several of these individuals merit specific mention. Brigadier General George Sternberg (1838-1915) was a premier researcher in the role of disinfection in disease prevention and editor of a report entitled *Use of the Röntgen Ray by the Medical Department of the United States Army in the War With Spain (1898).*[5] Sternberg served as the Surgeon General through the 1890s and became known as a pioneer in bacteriology. His association with Woodward and the museum's photomicrographic technologies enabled Sternberg to produce an early work on the subject and establish the museum as locus of significant American research on microbiology in general. As Paul Starr has pointed out in his work on the social transformation of American medicine,[6] these individuals pursuing microbiology did so not out of any stroke of fortune, but rather backed their interests with basic scientific research—chemical and bacteriological investigations—which allowed them to determine systematically the relations between causes, symptoms, and related lesions. However, Starr claims, few individuals understood and appreciated the potential impact of the role of immunization before the 1890s. It remained for a public health movement to make clear the role immunization might play in modern life.

It was in the military and at the Army Medical Museum that some of the earliest public health sentiments first saw expression in the early adoption of immunization policy and routine bacteriological research. In large part, this was due to the fact that from 1893 on, while the forward looking John Shaw Billings retained the position



Bacteriologist George Sternberg completed hundreds of photomicrographs during his work with the Army Medical Museum. He photographed this penicillium in a culture cell containing yellow fever in Havana in 1879. Although cumbersome, the photographic equipment often travelled with Woodward and Sternberg—evidence of the interest in and support for the relatively novel photomicrographic tool in research. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology, Negative Number 86-6640.)

of Director of the Surgeon General's Library and the Army Medical Museum, then Captain Walter Reed (1851-1902) assumed the role of Curator. In addition to his role as pathologist and caretaker of the collection, Reed pursued intense studies in clinical and sanitary microscopy. His work complemented Billings' interest and activities in environmental sanitation. The first major military applications of this relatively new sort of study took place during the Spanish American War and the epidemics it made so notorious—those of typhoid and yellow fever. Reed headed two formal military investigative boards dealing with both epidemics. The first was a panel established to consider the communication of typhoid fever in camps in American; the second task force studied yellow fever epidemics in Cuba.

Earlier boards had determined yellow fever was indeed transmissible through the air.[7] That idea had remained an intriguing one to Army physicians. Yet when asserted without overwhelmingly positive empiricial proof, the theory identifying a particular mosquito species as the agent of transmission met considerable resistance in those circles in which it received attention at all. Army researchers, Reed among them, undertook the study of the disease at the museum. The need for the investigation became imperative by 1900 when American forces occupied yellow fever-ridden Havana. Much of what followed is a relatively well-documented episode in the history of medicine in general and American military medicine in particular. Reed and two of his team of three main coworkers had been trained at the Army Medical Museum, whose staff's increasingly influential tradition of microscopic and bacteriologic investigations aided their labors and eventually supported their suppositions that insects might in fact carry the disease.

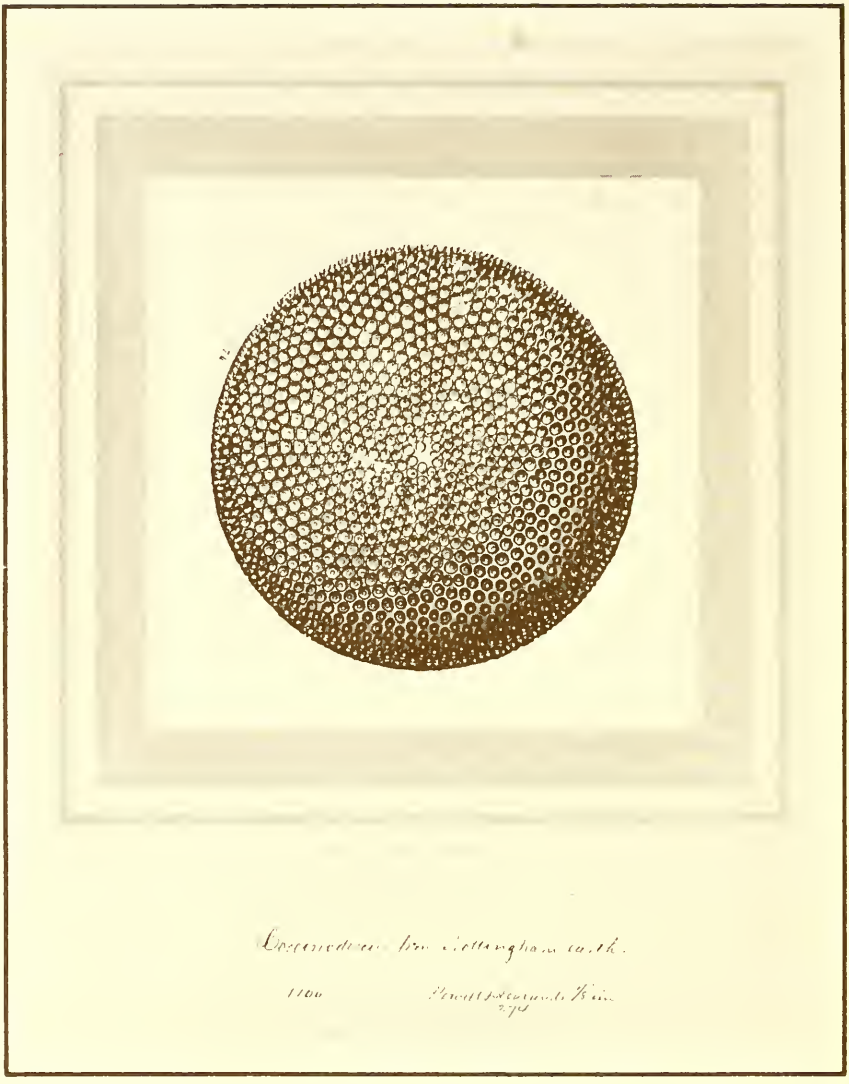
Reed's studies of typhoid, too, depended upon the nascent bacteriological investigation traditions of the museum. Set up in 1898, the Typhoid Board traveled to various military sites and employed museum trained microscopists to participate in the investigations. The success of the Typhoid Board contributed to the museum's reputation as a formidable and productive medical institution and brought increasing recognition to its professional staff.

Within a few years of the turn of the century, numerous personnel changes had taken place at the museum. The deaths of Walter Reed

and later his successor, Major James Carroll (1854-1907), placed then Captain Federick Fuller Russell (1870-1960) in the role of Curator in 1907. As Russell occupied both the curatorship of the Army Medical Museum and a professorship of bacteriology and microscopy, a clear message issued from the organization. The museum was more than the cabinet of curiosities it might have become. The vitality of its publications, the firm ties between the museum and significant contemporary research, and not the least, a vastly increasing collection of anatomical and pathological and skeletal collections, microscopic specimens, and over one hundred historic and modern microscopes conjoined to make the Army Medical Museum and its attendant school the site of much attention in the medical profession. Indeed, combining science and collecting was a natural step for the organization. Application of the research results was no less a powerful objective.

The development of a typhoid vaccination system was one such application. Any knowledge of the history of medicine makes it clear that the museum cannot claim any original rights to the idea of vaccination. Museum staff, however, can claim credit for one of the first large scale attempts to vaccinate an entire population with disease control as an aim. Volunteers for preliminary studies came to the Army Medical Museum for their innoculations. By 1909 the museum had established a laboratory for vaccine production and staff began a successful broad scale vaccination program involving nearly eleven thousand volunteers. Within two years, typhoid vaccination was compulsory for all of the members of the United States Army. A program initiated as a research protocol for a medical museum had effectively reached an entire military population, clearing the way for many facets of the public health movements. The museum's role in this agenda was clear. It had provided an intellectual milieu and laboratory setting in which this medical thought could progress, and its successful and significantly empiricial, observation-oriented learnings owed much to the techniques of bacteriologists and microscopists of earlier days.

A description of the Army Medical Museum in the 1880s, however, no longer did justice to the institutional organization. The museum and library were growing at such a rate that the newly enlarged facilities on the mall in Washington had become inadequate for medical officers. The Army Medical School eventually vacated its space in that building, allocating more to the museum.



J. J. Woodward produced this photomicrograph of Nottingham earth using a magnification of 1100 diameters and sunlight as the illumination. This is one of several thousand such photomicrographs. Well known in Washington scientific circles, Woodward's work was the focus of interdisciplinary interest. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6650.)

Additionally, the emphasis on bacteriology and original research activities had begun to overshadow the role of the museum as a collection to educate a medical professional community. Even so, specimens of various types and historical artifacts flowed into the museum, cementing its stature among medical collections as one of the greatest in the world. By 1916 the specimens alone numbered more than 47,000. This is not to say that an interest in morbid and microscopic pathology ever assumed complete salience over active bacteriological research; it never did. But the collection regained its significance with the medical activities in World War I.

The medical contribution of the Army Medical Museum continued unimpeded during the war. The museum continued its aggressive collecting of specimens for instruction and individual study in spite of considerable difficulties in actively obtaining the objects due to the rigors of wartime activities. Pathological anatomy had its staunchest supporter in the museum's staff pathologist, Daniel Smith Lamb (1843-1929). Even though more of the medical effort at various camps was clearly devoted to clinical microscopy, Lamb did his best to see that the critical importance of studying pathological specimens was undiminished. The museum continued to house an active pathology laboratory, but it did so in large part because Lamb lent the staff his own collection of museum microscopes and laboratory tools. The museum's contributions in World War I were by no means limited to laboratory or autopsy room findings. Its graphic arts department and illustration services produced educational posters and films by the dozens. The films were devoted to such topics as avoiding venereal disease, instructions on microscopic use, and how to move wounded. Work in photomicrography continued as well. The museum also pioneered in studies of roentgenocinematographs—a novel moving picture x-ray technique for cardiologic studies.

World War I collecting efforts brought the number of museum specimens to over 100,000. While caring for this large a number of specimens taxed a small staff, work on the collection itself actually formed the basis for numerous registries of pathology. Members of medical associations forwarded significant specimens to the museum for care and safekeeping in return for their use as teaching material. In addition, museum staff would make appropriate recordings about the objects. This collaborative "registry" movement, a product of the early 1920s, created a lasting

bond between civilian and military medicine and formalized a cooperative educational venture.

Through a long series of complex organizational changes, the museum's great library has become the National Library of Medicine. The Armed Forces Institute of Pathology, formerly the Army Institute of Pathology and earlier still, the Army Medical Museum, now comprises today's Armed Forces Medical Museum. Research demanding microscopes of increasing delicacy and capability continues unabated.

The mechanisms for collecting and educating a visitorship were in place well before these changes, as the preceeding pages have shown. A close look at one set of objects, the Billings Microscope Collection, will illustrate how these mechanisms have operated and reiterate how the collection is tied ultimately to the entirety of the museum.

The Armed Forces Medical Museum houses one of the largest and most comprehensive collections of microscopes anywhere. In some ways, examining the groups of objects as a corpus reveals as much about the medical world as does observing one instrument in particular. For that reason, in this article we consider the history and formation of the microscope collection as a whole. It is not our purpose here to advance a history of microscopes, their construction, optical systems, or a theory of microscopy, although some general statements about the instruments themselves are in order.

Many historians of the microscope begin their works with an assessment of all possible magnifying objects used throughout history.[8] While this approach is useful in grounding the story of the microscope firmly in ancient times, it belittles a significant point: the "invention" of the microscope coincides in time with the experimental method in science, in the early seventeenth century. By combining lenses with tubes and frames, the early optical instrument makers broke with the past and created new ways to view the universe, whether by telescope or microscope.

From the very first recorded applications of their instruments, microscope users have trained their gaze on the natural world. Whether observing whole insects, plants, cells, or human anatomical components, microscopists have turned to

The "Old Red Brick" was the home of the Army Medical Museum and later that of the Armed Forces Medical Museum. It held a major library, offices, laboratories and work space, as well as the museum. The building was razed to allow construction of the Smithsonian Institution's Hirshhorn Museum and Sculpture Garden. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number SC-179451.)

examinations of structural detail and biological units. Yet while many microscopists studied mites, amoeba, and possibly bacteria, not until the late 1680s were such organisms associated with disease. It was then that microscopists used their instruments to observe the itch inducing mite which passed among individuals.[9] Even with as useful an argument for the use of the microscope as that, the instrument met resistance among some scientific communities. Microorganism and germ theories, whether supported by microscopic observation or philosophical speculation, had no broad acceptance until centuries later. After all, the theories were relatively incommensurable with contemporary medical thought. As one author points out, in addition to being at odds with conventional wisdom, the microscope led physicians to conjecture about the very cause of disease.[10] Writers and medical thinkers no less than John Locke asserted that there was no reason to assume a relationship between the microscope and the microscopic predictions. He argued further that using the microscope even diverted physicians from their bedside gaze.[11] That argument was destined to be repeated often in the story of the microscope.

Just as important was the fact that while some microscopes might have helped foster germ theories, many microscopes simply offered poor optics and worse illumination. Although lovely objects to look at, these singular microscopes were sometimes difficult to use. Lens systems were uncorrected, in the modern sense of the term. The cardboard, wood, metals, plaster, bone and glass instruments of the time were the epitome of the instrument makers' art, but the viewer was often just as much an active manipulator as a possible user. Robert Hooke made this point clear in his 1665 *Micrographia* when he noted the difficulty in distinguishing prominences from depressions in a microscopic image and listed the many manipulative tasks involved in making an observation.[12] Some of these problems still exist today, although numerous improvements in optical and illumination system arrangements and lens manufacture advanced the potential image quality and the ease of use.

As opposed to so-called simple microscopes of one lens construction which had to be held close to the eye, the compound microscope offered a larger field of view and was more convenient to use. As Reiser and others have pointed out, however, these instruments were used mainly by amateur collector-microscopists.[13] Some scientists willing to use the microscope in their investigations

In addition to creating mobile laboratories, the Army established laboratories such as this one in France. For the most part, microscopes in laboratories saw use in bacteriological screening rather than primary research. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6642.)

preferred the simple scopes, and even then they were more inclined to place the fault of a poor image with an "unreliable" instrument than with its user. Combined with numerous other difficulties—illumination problems, specimen handling problems, the expense of purchasing such an instrument, and the fear that it was rather too cantankerous to operate in a facile way—the often poor image quality dissuaded potential users.

Despite these drawbacks to wide acceptance, certain groups made vast contributions to the microscopy. The instrument makers and leisure class amateur microscopists throughout much of Europe filled many hours observing, drawing and discussing the microscope's revelations. Even in light of rejection from other communities, these amateurs' enthusiasm for the instruments rarely diminished. During the course of the century, instrument makers displayed their virtuosity by incorporating improvements into existing microscope designs or creating entirely new conformations. Many of these innovations were copied for over a century and some remain durable ideas on microscope design today. Medical rejection notwithstanding, this period was an important one for the development of the microscope.

The eighteenth and early nineteenth century also saw the formation of new optical instrument firms and the reinvigoration of older instrument houses, some of which produced microscopes by the hundreds. Several of the innovations newly incorporated into eighteenth-century instruments include improvement to stages and the introduction of rack and pinion focusing. New lens arrangements began to appear, as did a hinged, inclining pillar system and fine adjustment screw focusing. New features in eye pieces became available.

Perhaps one of the most significant events in eighteenth century microscope development was that of the solar microscope. Several English manufacturers developed these instruments, which used sunlight to project images onto a screen. With this type of microscope, observation was removed from the realm of solitary endeavor. Now more than one individual at a time could view an image, and communities of observers could form for the first time.

Even those improvements, however, left several basic optical issues unresolved. Chromatic and spherical aberrations continued to plague microscope users, and it was not until the end of the

SILVERMAN ILLUMINATOR *for* MICROSCOPES

BULLETIN No. 45 SEPTEMBER, 1919

FIGURE 1

Applications: The Silverman Illuminator finds application in practically every field of microscopy, such as:

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BIOLOGY	RUBBER	INSULATING MATERIALS
PHARMACY	LEATHER	FIBROID
BOTANY	WOOD (effect of stains, etc.)	LINOLEUM COMPOSITIONS, ETC., ETC.

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Microscopists needed a wide array of accessories to the microscope itself in order to ply their trade. Lenses, special viewing tables, microtomes and illuminators are examples. This catalog, dated 1919, is in the Otis Historical Archives. Catalogs from the mid-nineteenth century are available, but tend to be less specialized. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6649.)

century that instrument makers applied existing optical technologies to the microscope to combat the problem. His studies of solutions to these drawbacks led Joseph Jackson Lister and others to create a scientific discipline from the empiricial art of lens construction by 1829. An additional problem solved early in the century was that of resolution and of the ability to calculate it and assess image quality.[14]

Numerous authors have pointed out that during the nineteenth century, some European medical schools began to support microscopic work in anatomy and pathology.[15] By the second third of the century, the instruments in use had become adequate for the study of microorganisms, making significant progress in bacteriology possible. By then microscopists contributed to studies in support of the germ theory of disease. Americans were beginning to manufacture microscopes in large numbers, ending their dependence upon European makers for their instruments.[16]

In addition to bacteriological studies, the use of microscopes helped push biological scientists into the sentiment that macroscopic post mortem examinations were less than adequate to advance pathology. Microscopic examination was called for as well. This view saw its clearest application in cancer studies. Microscopic examination of tumor structures eventually allowed advances in tumor classification. By the time various cell structure theories had been advanced, biological science was aided, even stimulated, by the microscope in the hands of a trained observer. This esteem was not universal, though. As Reiser points out, the medical schools which wholeheartedly adopted the microscope by the 1880s were few.[17] Only the medical schools at Harvard, the University of Pennsylvania and a handful of other locations could claim microscope laboratories. To this list we can add the United States Army Medical School.

One of the impacts of the microscope on medicine was the rise of bacteriology. The evolution and history of bacteriology have been addressed elsewhere in the literature and the role of bacteriology in the Army Medical School has been touched upon in the preceeding pages. In fact other research groups within the government coalesced around the microscope. Hunter Dupree, for example, cites groups in several branches in the Department of Agriculture in the 1880s. In addition to bacteriology, though, authors discuss another important aspect of microscopy in the nineteenth century. As with

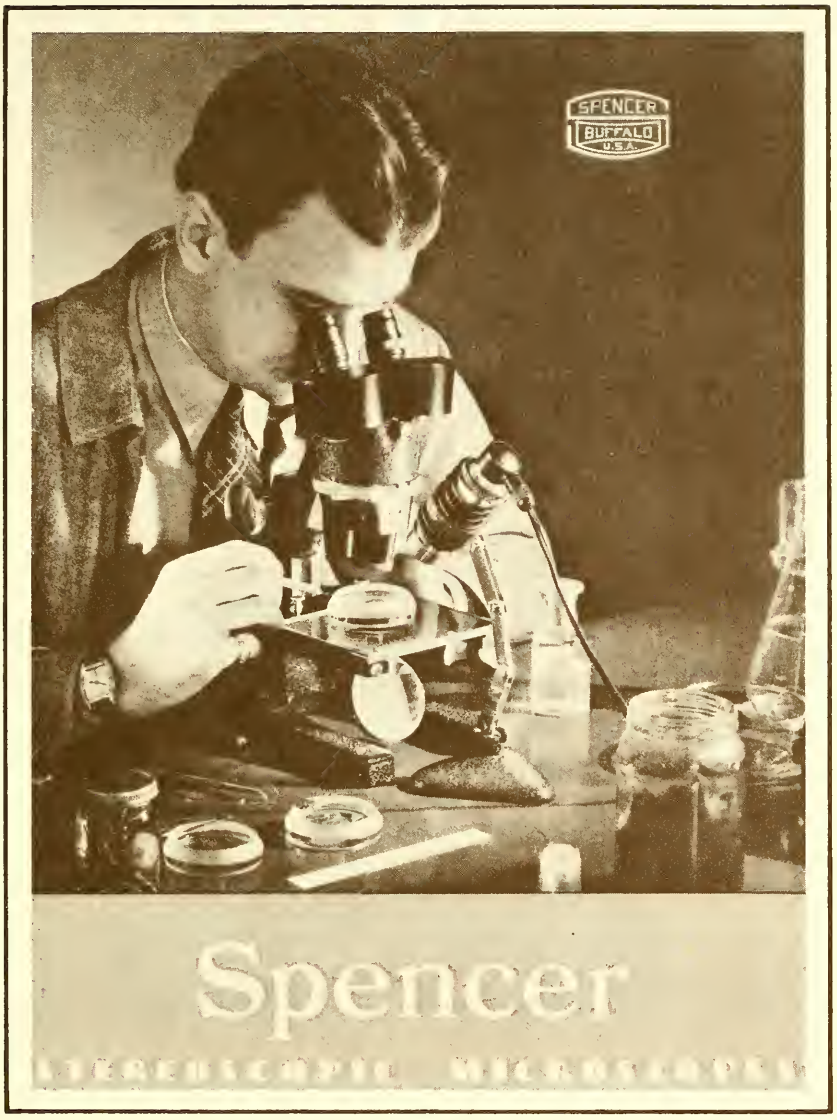
Benchside microscopy was not always a solitary endeavor. This 1920s Army medical laboratory shows two microscopists at work, with a third individual probably preparing specimens for view. Possibly taken at the "Old Red Brick" museum on the mall in Washington, D.C., this photo reveals the use of natural rather than artificial illumination. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6641.)

the x-ray and some laboratory tests, medical microscopists produced data independent of the subjective judgment of either patient or physician. Along with the advent of manual diagnostic instruments, this extended an existing trend toward the relative dismissal of the patients' subjective analysis.[18]

Tracing the technological development of the microscope and microscopy in the nineteenth century and into the twentieth is a task well beyond the scope of this work. A mere mention of the names involved in these fields—Robert Koch, Karl Rokitanski, Louis Pasteur—quickly becomes a litany of acknowledged medical thinkers of the highest order. By the middle of the nineteenth century, the microscope had "come out of the cabinet" and had become the focus of public attention.

The appearance of dozens of American, French, German and Japanese microscopes at the Philadelphia Centennial Exhibition in 1876 prompted Henry Crouch, a Fellow of the Royal Microscopical Society, to discuss them in the *American Journal of Microscopy and Popular Science.*[19] He compared the national styles of microscope manufacture, concluding that American microscopes could become the technological match for any others. Crouch found that compared to other observers, American microscopists lacked training and the collector's urge for comparative study. Some American institutions would try to change that. Indeed, the Army Medical Museum had already begun.

As noted in the preceeding pages, the Army Medical Museum's microscope collection contains some nine hundred microscopes, including examples of the oldest and perhaps most well known instruments in the world. Colonel George A. Otis initiated collecting activities when he presented his small group of Philadelphia-made microscopes to the museum in 1874. While the number of microscopes was small, their significance was not. There are two reasons. First, because there were few American microscope makers at the time, these represented the nation's optical instrument makers' art just as much as they did the beginnings of organized laboratory work in microscopy at the museum. Second, and equally important, is the fact that Otis was the first of a long list of illustrious individuals who contributed microscopes or appurtenances to this now-famed collection. If many others presented instruments, none did so more thoughtfully, methodically or generously than John Shaw Billings.



The museum collects trade catalogs for microscopes as well as accessories. This catalog, in the Otis Historical Archives, dates to the 1940s and illustrates a growing specialization of use and manufacture. These catalogs reveal a great deal about the microscope and, equally significant, its marketing. One can learn not only technical information, but about price structure and availability as well. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6646.)

As anyone familiar with the history of American medicine is aware, Billings was a key figure in the field. As such, he has many biographers, and has been celebrated variously as medical educator, physician, author, hospital planner, architect, fund raiser, bibliographer and statistician. He is even credited with having inspired Herman Hollerith to use the punch-card principle in developing an electrical tabulating device.[20]

Throughout his thirty years in the medical field, Billings collected microscopes for the museum, chiefly during the decade he was Curator, from 1883 to 1893. Much as been written about his careers elsewhere in the medical profession and in his roles as researcher and bibliographic collector. Less is known of his virtuosity as a microscope collector. The year after he assumed the curatorship, Billings began to cultivate what would become a seven-year-long association and collaboration with John Mayall, Jun. of London, an acknowledged expert on the history of the microscope. Billings commissioned this instrument collector and secretary of the Royal Microscopical Society to obtain microscopes for the Army Medical Museum. Mayall had been an avid collector of optical instruments since the 1850s. By the time he made the aquaintance of the world renowned Billings in 1884, Mayall had assembled his own collections, written widely on scientific instrumentation, and contributed numerous microscopes to the Royal Microscopical Society. A scholar of wide reputation and great expertise himself, Mayall delivered the Cantor Lectures on the microscope and its history. The lectures were subsequently published, along with numerous drawings and engravings, in 1886 in the London *Journal of the Society of Arts.*[21]

Mayall initiated their lengthy correspondence by writing to Billings in October of 1884. Aware that he was to collect and purchase historic microscopes for the museum at Billings' behest, Myall questioned the nature of the Army Medical Museum's collection, Billings' plans for it, and his own role as agent. He also offered for purchase eleven English microscopes. Billings' response as a scholar, collector and respectful admirer of the instrument maker's art must have satisfied Mayall. Advancing his own funds in the amount of 220 English pounds, Billings purchased the eleven microscopes for the museum. Billings noted, however, that that sum exhausted his funds for nearly a year. He wrote, "It must be something very rare and extraordinary that will induce me to purchase any more miroscopes before June."[22]

The Billings Collection includes numerous novelty microscopes as well as scientific instruments. This French microscope was manufactured in 1850 and extends to a full height of four and one-half inches. Novelty microscopes have never been rare. Fine presentation pieces, fashioned more to be looked at than looked through, account for microscopes from as early as the seventeenth century. Still others, like this one, were parts of a series of "toy" microscopes, appealing as much to the instincts of play and amusement as to serious work. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. AFIP Negative Number 60-4713-268.)

Mayall accepted the challenge. In the remaining years of his life, the Englishman assembled an immense collection of microscopes, accessories, and books on optical instruments from collectors and merchants in the British Iles and on the Continent, unrivaled except perhaps for the Royal Microscopical Society's collection. Billings both purchased instruments and accepted as donations over one hundred microscopes through or from Mayall. Interestingly enough, some of the instruments received as "historic" became working additions to the museum's laboratories and photomicrographic equipment.

As Billings' thoughtful and constant agent, Mayall was often on the lookout for instruments for the Army Medical Museum. A case in point follows. In February of 1886, Mayall offered Billings the opportunity to purchase a set of microscopes for 250 pounds sterling. Mayall considered the instruments of the "highest possible interest." Among the objects Mayall investigated for Billings were Robert Hooke's large compound microscope (similar to the one pictured in his 1665 *Micrographia* and manufactured by London's Christopher Cock), an Italian compound microscope from the Companie shop probably dating 1665-1670, an Eustachio Divini instrument of the same period, and five other microscopes dating to about 1700 or earlier. These instruments had been carefully preserved in a glass case by their owners, he speculated, for he saw that the gilding on the instruments was in excellent condition, and no microscope evidenced signs of wear or neglect. Mayall did not reveal the recently deceased owner's identity to Billings. He did not indicate that the owner had been aware of their singular importance, but that his executors insisted that the microscopes be disposed of as an intact group. Were it not for that condition, Mayall admitted, he would have purchased some for the Royal Microscopical Society. The asking price of 250 pounds for the set seems to have surpassed Mayall's available funds, however.

Mayall presented his case for purchase to Billings, fairly entreating him to take advantage of the opportunity. Regarding the instruments as priceless from the antiquarian view, Mayall argued: "One might search through Europe (as I have done) and even then not succeed in purchasing such treasures, representing as they do the practical origin and very early developments of the construction of the microscope." Mayall continued to comment on the rarity of such an opportunity, pointing out that it was extremely difficult to find such instruments, no matter what one

This makeshift World War II laboratory includes a portable microscope of a type well-represented in the Billings Collection. The photograph typifies the image of the scientist as a man peering into his microscope, establishing this individual as a serious and learned man. In fact, this generalized image of the scientist looking through a microscope (or telescope) has long been in place as a standard depiction of the profession. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-7455.)

might be prepared to pay for them. He asked Billings to consider the matter carefully, and concluded: "I have never met with such a collection for sale before, but have collected them most laboriously, here and there in the course of some 50 visits to the continent, devoting my whole energy to the search." Billings responded in March that the asking price was not within his reach, but offered to purchase the lot for 200 pounds if payment might be deferred until July.

Mayall's lengthy response revealed much about the late nineteenth-century view of microscopes, optical instruments, and the responsibilities of collecting in general. He reiterated the extreme value of the collection as a whole, and the unlikelihood that such an opportunity might even arise again. Part of the letter bears repetititon: "I have gone over Europe with the fullest possible authority to acquire such instruments, but have never met with anything approaching this collection in importance *at one find.* I have thought myself lucky if a journey of 2 or 3 weeks has resulted in finding of a single model of date anterior to about 1750."

The Englishman did not relent. In his next letter to Billings, he included the following revealing passage about antique microscopes:

> I have purchased every model obtainable anterior to 1750, and they amount to so few that visitors to our collection almost invariably exclaim, "How very singular that you have so few very early microscopes!" I have then to explain that in the early years there was no regular production of microscopes. There were no opticians devoting themselves to the manufacture as a business, because there was no demand for them.

Mayall also explained that the earliest instruments were made of readily perishable or breakable materials, often damaged by neglect. The irregular metalwork which did survive often was not understood by succeeding generations, and hence could not be long preserved.

Continuing his appeal to Billings, Mayall pointed out that the "early microscopes were either made by their inventors or by here and there a mathematical instrument maker. There was no real demand for them; consequently no regular manufacturer.... Well

Military medical laboratories increased in size throughout the period between the wars to handle swelling numbers of military personnel and research needs. This World War II blood typing laboratory contains at least ten microscope stations capable of simultaneous use. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6644.)

preserved microscopes of the 17th and early part of the 18th centuries are extremely rare." However, Billings stood firm. Eventually Mayall accepted Billings' offer of 200 pounds and the delay of a few months.

Over the course of their seven-year correspondence, Mayall arranged for the Army Medical Museum to acquire nearly one hundred original and reproduction scopes and books for its displays. Twenty-one of the microscopes appeared in the pages of Mayall's Cantor Lectures. The Billings microscope collection was well begun.

Billings continued to purchase instruments and accept the generous donations of microscope manufacturers and users or of their families. Since his large scale expansion of the collection, microscopes and accessory pieces such as lenses and illuminators have come to the museum through many channels. These items have been purchased by the museum or its staff and benefactors, willed to the museum, exchanged for other instruments or accessories, donated, found in laboratories, attics and elsewhere, and transferred through government channels to the Armed Forces Medical Museum. Over the years, museum staff have accumulated optical and electron microscopes which run the gamut of types, sizes and uses. They are simple or compound, monocular or binocular, unique or mass produced. Some of their number have been used or produced by such luminaries as Robert Hooke, Rudolf Virchow, Walter Reed, James Ewing, Joseph Gardner and numerous American manufacturers such as Charles and Herbert Spencer, to name but a few. Some are included less for the significance of their user or manufacturer than for their representation of modern medical science. For instance, several microscopes used by the fledgling Food and Drug Administration in 1906 to examine products for adulteration or spoilage and main sections of the first million volt electron microscope in this hemisphere are included.

In addition to very old microscopes, museum staff have actively sought more recent models, particularly those of American origin. Whether by word of mouth or in the pages of publications such as *JAMA,* these efforts have been successful. As a response to this sort of solicitation and publicity, in 1966 the museum received its largest single collection of microscopes next to the contributions of Billings himself.

Dutch psychiatrist and collector Dr. A.J.W. Kaas offered a large collection of ninety microscopes and numerous accessories for sale to the museum in July of 1965. Officials of the Armed Forces Institute of Pathology arranged for Army personnel in Europe to evaluate the collection. Subsequently, the institute purchased the collection. In it are many of seventeenth-, eighteenth- and nineteenth-century microscopes which complement the existing collection.[23]

Since then the Armed Forces Medical Museum has continued to accumulate numerous microscopes and accessories. Museum staff also have amassed an extensive assortment of complementary collections—microtomes, illuminators, catalogs, manuals, photographs and other publications—which support research in and about the collection.

The Billings collection and related objects offer a look at the evolution of numerous technologies as well as a history of the Armed Forces Medical Museum and its science. More than merely providing a safe repository for this extensive collection of microscopes, the museum also has influenced instrument design and had an impact on their use. Photomicrography, as advanced by Sternberg and Woodward, helped to lessen the highly subjective nature of microscopic investigation. By producing a single hard copy of a microscopic image, scientists who might otherwise find disparity in their observation could appeal to what served as a single "objective" impression. Additionally, accommodating the microscope to techniques of photomicrography has influenced the construction of accessories, particularly in American microscopy.

These supporting collections, then, can help generate a number of interesting questions about the main collection. One can and must address such issues as: How were the objects made? By whom and when? Who used them? For what purposes? Were they unique or mass produced? Heirlooms or laboratory instruments? Were they passive tools in the hands of their users? Or did they actively affect the user? What role did users play in innovation?

In beginning to address some of these questions, we have illustrated that the individual objects and the collection of objects as a whole can be tied to the history of the institution which houses them. At the very least, this impressive collection is concrete evidence of efforts toward scientific advance and the vitality of research at the Armed Forces Medical Museum.

Blood typing during the Korean Conflict, at both battle's edge and at Mobile Army Surgical Hospitals, frequently demanded microscopes like the ones pictured. Even in this most informal setting, the appearance of the instrument lends an air of consequence and importance to the scene. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-7456.)

NOTES

1. For general and technical histories of the microscope, see S. Bradbury, *The Microscope Past and Present* (Pergamon Press, 1968); William B. Carpenter, *The Microscope and its Revelations* (Philadelphia: P. Blakiston's Son and Co., 1901), pp. 117-269; Reginald S. Clay and Thomas H. Court, *The History of the Microscope* (London: Griffin and Co., 1922); Alfred N. Disney et al., *Origin and Development of the Microscope* (London: The Royal Microscopical Society, 1928); Silvio A. Bedini, *Early American Scientific Instruments and Their Makers* (Washington, D.C.: The Smithsonian Institution, 1964); and Donald L. Padgitt, *A Short History of the Early American Microscopes* (Chicago: Microscope Publications Ltd., 1975).

2. See *The Medical and Surgical History of the War of the Rebellion*, 6 vols. (Washington, D.C.: The Government Printing Office, 1888).

3. Robert S. Henry, *The Armed Forces Institutes of Pathology, Its First Century, 1862-1962* (Washington, D.C.: Office of the Surgeon General, Department of the Army, 1964). This work includes numerous photographs, such as those of the museum in its various locations and most individuals mentioned in this work. For general information on the history of the Armed Forces Medical Museum, see also D.S. Lamb, *A History of the Army Medical Museum,* 1862-1917 (Washington, D.C.: Otis Historical Archives, Armed Forces Medical Museum, Armed Forces Institute of Pathology, 1917). The Otis Archives also houses curatorial and other records of the museum.

4. John Shaw Billings, "On Medical Museums, With Special Reference to the Army Medical Museum at Washington," *The Medical News 53* (September 22, 1888): 314. Smithson's bequest to the United States included "an establishment for the increase and diffusion of knowledge among men." See, for example, Edward P. Alexander, *Museums in Motion* (Nashville: American Association for State and Local History, 1979), pp. 50-51.

5. See *Use of the Röntgen Ray by the Medical Department of the United States Army in the War With Spain (1898).* Prepared under

the direction of Surgeon General George M. Sternberg, United States Army, by W.C. Borden, Captain and Assistant Surgeon, U.S. Army (Washington, D.C.: The Government Printing Office, 1900).

6. Paul Starr, *The Social Transformation of American Medicine* (New York: Basic Books, Inc., 1982), pp. 135-139.

7. The Jefferson Medical College of Philadelphia, "Yellow Fever: A Symposium," (September 22-23, 1955): pp. 4-5. There are numerous other histories of yellow fever, including Howard A. Kelly, *Walter Reed and Yellow Fever* (Baltimore: Medical Standard Book Company, 1906); Walter Reed, "The Propagation of Yellow Fever," *Medical Record 60* (August 10, 1901): 201-209; and Albert E. Truby, *Memoir of Walter Reed: The Yellow Fever Episode* (New York: Paul B. Hoeber, Inc., 1943).

8. Carpenter, *The Microscope and Its Revelations*, pp. 117-126; and John Mayall, Jun., "Cantor Lectures: The Microscope," *Proceedings of the Society of Arts,* London *37* (September 3, 1886): 987-992. Carpenter makes liberal use of Mayall's Cantor Lectures of 1886 in *The Microscope and its Revelations.*

9. A familiar story to historians of medicine and microscopy, it is told best perhaps in Stanley Joel Reiser, *Medicine and the Reign of Technology,* (New York: Cambridge University Press, 1978), pp. 72-74. Reiser's chapter, "The microscope and the revelation of a cellular universe," pp. 69-90, is a useful, basic and clear treatment of the topic.

10. *Ibid.*

11. *Ibid.*, p. 73.

12. Robert Hooke, *Micrographia* (London, 1665). See also Mayall, *Proceedings*, p. 1011. There are numerous editions and republications of this work.

13. Reiser, *Medicine and the Reign of Technology*, pp. 69-90; and Charles Webster, *The Great Instauration: Science, Medicine and Reform, 1626-1660* (New York: Holmes and Meier Publishers, 1975), pp. 165-171. Webster's work includes a masterful treatment of Baconian era science and includes numerous references to Hooke, microscopy, and scientific instrumentation in general.

14. Reiser, *Medicine and the Reign of Technology*, p. 76.

15. There are several general histories of pathology. Among the most easily accessible are Esmond R. Long, *A History of Pathology* (Baltimore: Williams and Wilkins, 1928) and Esmond R. Long, *A History of American Pathology* (Springfield, IL: Charles C. Thomas, 1962). Another useful and thorough work is W.D. Foster, *A History of Medical Bacteriology and Immunology* (London: William Heinemann Medical Books Ltd., 1970), p. 6.

16. Donald L. Padgitt, *A Short History of the Early American Microscope* (Chicago: Microscope Publications Ltd., 1975), pp. 1-5. See also Silvio A. Bedini, *Early American Scientific Instruments and Their Makers* (Washington, D.C.: The Smithsonian Institution, 1964); and *Three American Microscope Builders* (Buffalo, New York: American Optical Co., 1944).

17. Reiser, *Medicine and the Reign of Technology*, p. 81; and James G. Burrow, *Organized Medicine in the Progressive Era* (Baltimore: The Johns Hopkins University Press, 1977), pp. 36-37.

18. A. Hunter Dupree, *Science in the Federal Government,* (Cambridge, MA: Harvard University Press, 1957), pp. 167-168; Paul Starr, *The Social Transformation of American Medicine,* pp. 136-147; Reiser, *Medicine and the Reign of Technology,* pp. 43-44. In general see Audrey B. Davis, *Medicine and its Technology* (Westport, CT: Greenwood Press, 1981).

19. Henry Crouch, "On Microscopy in the United States," *The American Journal of Microscopy, and Popular Science 2* (May 1877): 53-55.

20. Stan Augarten, *Bit by Bit, An Illustrated History of the Computer* (New York: Ticknor and Fields, 1984), pp. 70-71; The Office of Charles and Ray Eames, *A Computer Perspective* (Cambridge, MA: Harvard Univerity Press, 1973), p. 23; and S. Weir Mitchell, *Biographical Memoir of John Shaw Billings, 1838-1913, with the Scientific Work of John Shaw Billings by Fielding H. Garrison* (Washington, D.C.: National Academy of Sciences, 1917), pp. 375-416.

21. John Mayall, Jun., "Cantor Lectures. The Microscope," *Proceedings of the Society of Arts, London, 34-36* (September 1886-November 1888).

22. John Shaw Billings to John Mayall, November 1, 1884, Record Group 3, Curatorial Records, Otis Historical Archives, Armed Forces Medical Museum, Armed Forces Institute of Pathology, Washington, D.C. All Billings-Mayall correspondence is in this collection.

23. Helen R. Purtle and John A. Ey, Jr., eds., *The Billings Microscope Collection of the Medical Museum, Armed Forces Institute of Pathology,* Second Edition (Washington, D.C.: Armed Forces Institute of Pathology, 1974.) This work offers descriptions of most of the microscopes in the Billings group, including photographs of many of the instruments.

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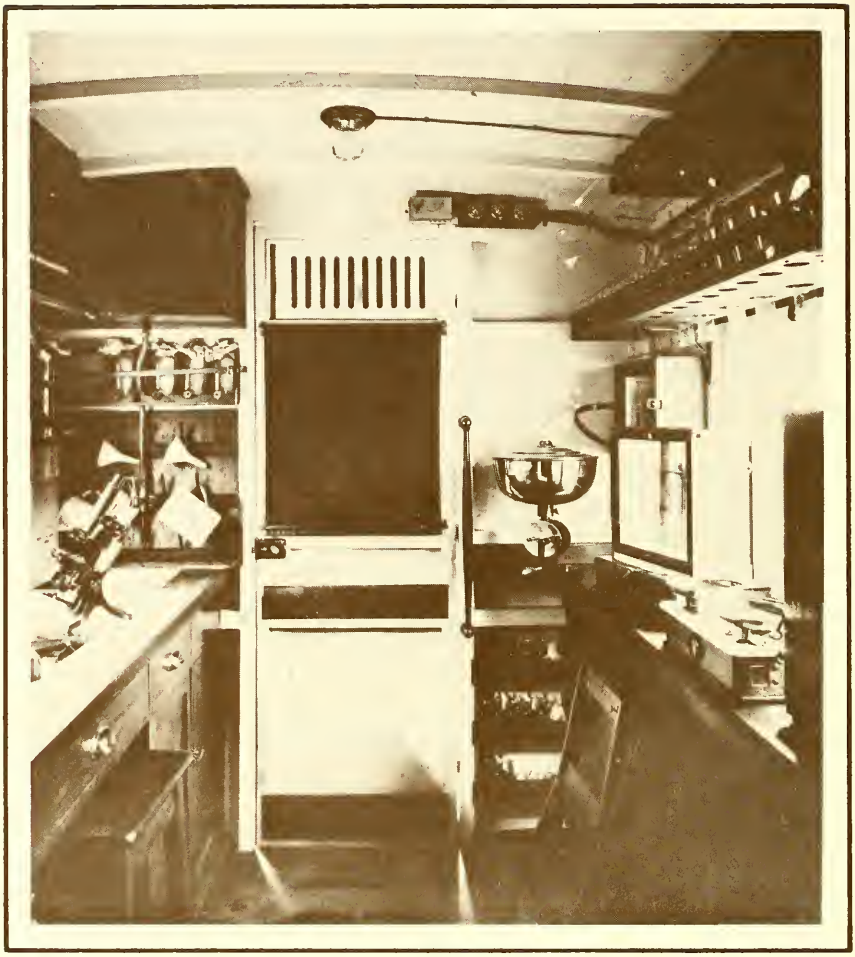
(The authors would like to acknowledge the generous assistance of Ann Elizabeth Zibrat in the preparation of this article.)



During World War I, the U.S. Army developed numerous mobile research and evaluation laboratories. This laboratory, although unusual, was not unique. Complete with travelling microscopes, it occupied part of a train car and served varying wartime medical functions. (Photo courtesy of the Armed Forces Medical Museum, Armed Forces Institute of Pathology. Negative Number 86-6647.)

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George Cowan is a full-time associate professor of surgery at the University of Tennessee College of Medicine, Memphis, Tennessee. After completion of his surgery residency in 1970 at Jefferson Medical University Hospital in Philadelphia, he became board certified in general surgery and took the position of Chief, Shock and Trauma Branch in the US Army Medical Research and Development Command. Early in his Army career, he was awarded a Surgeon General's Research Fellowship in cardiopulmonary physiology for two years at the Cardiovascular Research Institute in San Francisco, California.

In addition to his clinical practice, teaching and research, Dr. Cowan serves as Consultant to the Armed Forces Medical Museum, Armed Forces Institute of Pathology. He has made about fifty contributions to the medical and scientific literature, including the publication of a book entitled *Intravenous Hyperalimentation.* He is currently working with Ms. Nŏe on a third edition of *The Billings Microscope Collection,* to be published by the Armed Forces Institute of Pathology.

The opinions or assertions contained in this essay are the private views of the authors and do not necessarily reflect those of the Department of the Army or those of the Department of Defense.

FROM THE EDITOR

The name Medical Museums Association (MeMA) was formally adopted at the second annual meeting of persons interested in history of medicine museums. The meeting was held in Rochester, New York, in conjunction with the American Association of the History of Medicine (AAHM) conference on May 1, 1986. In addition, a constitution was considered and returned for amendment to the By-Laws Committee, which is chaired by Mark Dreyfuss.

The following officers were elected:

Pat Gerstner, President
Michael Harris, Vice President
Mark Dreyfuss, Secretary-Treasurer;
and Council Members, Felicity Nowell-Smith, Gretchen Worden,
Lisa Dziabis and Polly Coxe

Pat Gerstner organized this year's meeting with the assistance of James Edmonson. A delightfully illustrated program was presented by Robin Ripps on the medical history programs and exhibits at Colonial Williamsburg.

Twenty-nine people from nineteen institutions attended this year's meeting in Rochester. They agreed to convene the third annual meeting between April 30 and May 3, 1987 in Philadelphia, again in conjunction with the AAHM.

Membership dues were set at $15.00 or $20.00 for joint membership with the European Association of Museums of the History of Medical Sciences. Members are offered reduced subscription rates to CADUCEUS.

Send inquiries about membership and reduced subscription rates (for individual memberships only) to:

James Edmonson
Howard Dittrick Museum of Historical Medicine
Cleveland Health Sciences Library
Cleveland, OH 44106

or call: (216) 368-3648.

The Classification of Artifacts at the Howard Dittrick Museum

Patsy Gerstner and Judith Chelnick

The Howard Dittrick Museum of Historical Medicine in Cleveland is engaged in a reclassification of its entire collection. The goal of this project is to provide easier access to the objects and the information about them through a subject indexing system. It has been evident for several years that the museum's twenty-five-year-old system of categorizing medical instruments and equipment in broad categories and then subdividing the contents of each category according to instrument generic names was ineffectual, inefficient and contributed to the paper "loss" of objects within the total collection. Surgical knives, for example, might have been found under categories such as General Medical Equipment, or Surgical Equipment, or Dentistry, etc.

Resolving this kind of problem is a source of ongoing concern for all historical museums and efforts to find an orderly and efficient way to classify and organize historical objects have been underway for many years. Many historical museums have turned to the work of Robert Chenhall, who developed the basis of a name index for historical objects in 1978.[1] However, the Chenhall nomenclature is inadequate for highly specialized collections such as those in the history of medical technology. While the Dittrick Museum could have chosen to undertake the enormous task of creating an entirely new system to correct the immediate shortcomings in the old one, we turned instead to an experimental application of a small segment of the National Library of Medicine's *Medical Subject Headings* (MeSH) collection.[2]

Libraries have faced the problems of classification and subject indexing for more than a century, and this detailed subject list for medical books proved successful in the first trial application initiated six years ago at the Dittrick Museum. We subsequently applied for and received a grant from the National Endowment for the Humanities to implement a subject index for our entire collection of about 50,000 objects based on the MeSH system. The project began in January of 1985.

MeSH is designed to index medical literature using a card catalogue in a medical library. As in any library, the card catalogue is used to provide information as to the whereabouts of material relating to a particular subject. The medical subject authority list is developed by the National Library of Medicine. As all library users know, while books are arranged on shelves within broad categories, a card file is a straight alphabetical listing of subjects. We believe that this alphabetic listing of artifacts according to subject is the optimum key to retrieval and should be the primary consideration. Categorizing first leads to the separation of like objects as noted above and obscures technological and functional relationships.

An important consideration in classifying objects is always the variety of names under which the same or similar items may be known. This problem seems even more overwhelming with medical artifacts than it is with other kinds of equipment. Although of necessity we must be aware of such variations as we assign subjects, the compilation of a thesaurus of names is not currently a major thrust of our project. MeSH often provides subject names that are quite specific for instruments (for example, Bone Nail). More often the subject names reflect the function of an object in a somewhat less specific way (for example, Blood Pressure Determination). In either case, however, we must know the function of the object, not merely its name, before the subject is assigned. When questions arise concerning the function or purpose of an object, we have adopted *Stedman's Medical Dictionary* as a final authority.[3] In a project such as this, the need to approach the adopted authorities, MeSH and Stedman, as benevolent despots cannot be overstated. Anything short of determination to stick to the adoptee will be the undoing of the system.

It is important to recognize that MeSH was developed for literature and not for three-dimensional objects. It is, therefore, inevitable that some modifications or additions to the subject index are necessary for artifacts. Some MeSH headings (for example, Surgical Instruments) are useless for an artifact collection and must be ignored. Others must be added to accommodate collection needs. For example, since the integrity of the contents of an amputation set is inherently important, we created a category called "Surgical Sets" for retrieval of these and related sets. We also use subheadings that may or may not be MeSH. These are developed to help differentiate objects within a given functional

category. Cross-referencing is a critical part of our indexing for the retrieval of information. Cross-referencing for the retrieval of information is controlled, but only enough so that the retrieval possibilities are enhanced as fully as we think advisable.

We have taken our subject indexing a step further than our card catalogue and are rearranging the physical storage of artifacts in accordance with the alphabetical subject index. Obviously, the physical object cannot be stored in two places. Therefore, it has been necessary to assign what we call "primary" subject headings that indicate the functional relationship that we deem to be the most important for storage.

The following are examples from our subject list:

PRIMARY HEADING	CROSS-REFERENCE
Anesthesia, Inhalation	
Bottle and dropper	
Inhaler (incl. masks & accessories)	
Machine	
Substance	
Artificial limb	Prosthesis, orthopedic equipment; E4.557
Auditory prosthesis	Prosthesis
Auscultation	Heart function test; E1.706; E1.145; E1.302
Phonendoscope	
Stethoscope	
Autopsy (set only)	Appropriate category for each instrument
Ballistocardiography	Heart function test; E1.145
Balneology	Physical therapy
Bandage (except spray on; for this see Occlusive dressing)	First aid
Blood coagulation test	Hematologic test; E1.223

The numbers that appear under cross-reference entries are MeSH tree structure numbers with which we are currently experimenting as a way to secondarily access broad categories of artifacts. All subject headings currently in use by library indexers are arranged in a hierarchical manner showing relationships between broader and narrower terms. This tree structure, when applied to artifacts, will allow us to retrieve by categories such as "diagnosis, cardiovascular," or "orthopedics," or "surgery, plastic," etc. This arrangement will provide a quick and useful means of identifying categories of instruments when necessary and will be particularly easy to do when we computerize our records as is now being planned. It is our intention to computerize our catalogue records in the near future, utilizing a local library computer network, both as the point of cataloguing and as a first step toward what we hope will be the eventual placement of our computerized data on a national library computer network. In this way artifacts, in addition to written documents, will be available to scholars via computerized retrieval.

This project has made possible a careful study of the museum's collections of a kind not made in recent years. The rearrangement of storage according to the primary headings in effect has created a study-storage collection, and our ability to serve users through the retrieval of information and objects has increased a thousand-fold. As we continue with the project and approach its final stages, we are looking forward to an expanding awareness of our collection. The successful completion of the project will bring new prospects for exhibits, research, and publications.

While we cannot fully explore our work here, we are always pleased to discuss it in more detail and to share our experiences and work with others.

NOTES

1. Chenhall, Robert. *Nomenclature for Museum Cataloging. A System for Classifying Man-Made Objects.* American Association for State and Local History, 1978.

2. *Medical Subject Headings, Annotated Alphabetic List, 1985* (PB84-216084) is an alphabetic list of all subject descriptors used by indexers and cataloguers at the National Library of Medicine. For more information, contact the National Library of Medicine, 8600 Rockville Pike, Bethesda, Maryland, 20209. An important contributing factor in our decision to use MeSH was the fact that the Dittrick Museum is part of the Cleveland Health Sciences Library, and we therefore benefited from the daily opportunity to observe and study MeSH in use and from the enthusiasm of many librarians for our project that led them both to encourage and help us.

3. *Stedman's Medical Dictionary,* 24th Edition. Baltimore: Williams & Wilkins, 1982.

AUTHORS

Patsy Gerstner is Chief Curator of the Historical Division of the Cleveland Health Sciences Library, which includes the Howard Dittrick Museum. Judith Chelnick is Assistant Curator of the Dittrick Museum and has been responsible for the implementation of the system.

ART OF THE EYE: AN EXHIBITION ON VISION

ART OF THE EYE: AN EXHIBITION ON VISION represents a new kind of museum exhibition. Instead of merely gratifying the sense of sight, the works in this exhibition have been designed to transform the way in which we see. Organized by FORECAST Public Artspace Productions in cooperation with Minnesota Museum of Art and the Minneapolis Society for the Blind (MSB), ART OF THE EYE explores the dimensions of vision impairments through the eyes of twenty-four comtemporary American artists. Originated by Scott Nelson, a Minneapolis sculptor with retinitis pigmentosa, this unique exhibition has been designed to "examine perspectives influenced by the vision restrictions of both contemporary and historical artists."

CADUCEUS is pleased to reprint the following description of ART OF THE EYE, which has been abstracted from Maria Klein's Preface to the exhibition catalog with the kind permission of FORECAST Public Artspace Productions.

Conceived by Scott Nelson, a Minneapolis sculptor, ART OF THE EYE is a visual art exhibit about the nature of perception by artists with vision impairments. If there seems to be any irony or paradox in Scott's concept, it is only because so little information about vision impairment, including his, has been made available to us, the "normal-sighted" public.

Where there is ignorance, fear and misconceptions abound. It is perhaps understandable, if not productive or logical, that we make assumptions about any handicap or disability because society has

Laurel Cazin. I Wear a Mask to Hide My Emotions, But Cannot Escape *(18" x 24" black-and-white photograph, courtesy of FORECAST Public Artspace Productions).*

tended to segregate the disabled from the general population. Historically, we have had little opportunity to interact with disabled individuals so as to overcome our ignorance and fears. This lack of opportunity has reinforced our antiquated and bankrupt notions of the disabled as poor unfortunates condemned to bide time on the periphery of society. We tend to patronize exhibits of art by the handicapped, attending them as a kind of civic responsibility, viewing "handicapped art" as "therapy," a remarkable achievement by helpless individuals with nothing else to do.

With the vision-impaired, we tend to assume that, aside from a touch of myopia or middle-aged presbyopia, people are either "normal" or "blind;" some blind people themselves disallow the distinctions implied by the term "vision impairments." The concept of visual art made by someone with a vision disorder is incomprehensible in the shadow of our misconceptions.

Society is just beginning to learn that its notions about disabilities and disabled individuals are indeed misconceived and destructive. ART OF THE EYE attempts to further this learning process by presenting art created especially for the purpose of raising questions about vision and the nature of perception.

The process of communication in any language depends on a frame of reference built from agreed-upon symbols for objects and experiences in the physical world. Eyesight is critical to the process of gathering and evaluating information about this world in order to establish a common notion of "reality." The importance of eyesight is reflected in our language: to have a view-point is to take a conceptual position; to look into something is to investigate it; to see something is to understand it. Though art may question our notions, the artists and their audiences are usually starting from the same frame of reference.

What happens to communication when the common frame of reference is disrupted or even destroyed by vision impairments? How much does an impairment or a particular perception actually influence a work of art? How should a normally sighted audience interpret artwork when their visual perception of a finished piece differs from that of the artist? How can the audience understand the visual communication if they are ignorant of either the process of seeing or the many ways in which seeing can be impaired? And

how can an exhibit or art avoid or transcend the sterotypes and misconceptions so often associated with "handicapped artists" exhibitions?

ART OF THE EYE challenges artists and audiences alike to address these questions and issues by means of the art itself and the artists' statements. ART OF THE EYE follows in the tradition of art that calls attention to social problems and attempts to effect change. Art is an eloquent and powerful communication tool which has been used throughout the ages to document and comment on the human condition, to educate or indoctrinate, to illustrate ideas and values, to criticize, to champion a cause, or to express feelings. At the very least, art can serve as a touchstone for dialogue about important and sensitive issues.

In addition to promoting social consciousness, the ART OF THE EYE exhibition hopefully will encourage a reexamination of the traditional history of art in terms of vision impairments and their possible effect on the perception and work of influential artists of the past. In a course at the American Academy of Ophthalmology, Dr. James G. Ravin, a Toledo ophthalmologist and art historian, explores in depth the vision disorders of many great masters. With Dr. Ravin's assistance, an audio visual summary of his course was developed especially for ART OF THE EYE.

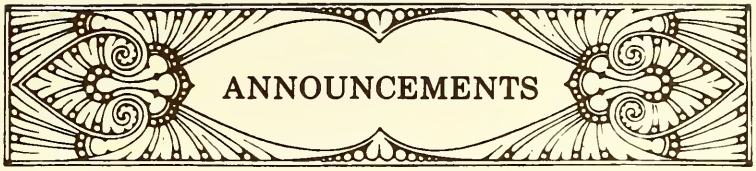
Dr. Ravin's article, "Monet's Cataracts," first appeared in the *Journal of the American Medical Association* in July, 1985. Prior to the publication of Dr. Ravin's article, little influence was assumed, much less understood, about Monet's shifting color usage in his later periods—the periods of the Japanese bridges and water lilies. Dr. Ravin's article points out how little is known, even by doctors, about most artists' perception and its function in the creative process.

It may be useful to organize an exhibition of historical works in order to try and evaluate the relationship between how vision-impaired artists like Monet saw, and the effect their vision impairments might have had on their work. Dr. Ravin's survey of artists with recognized vision impairments has already raised important questions about the crucial role of vision in the creative process, and certainly prompts new interest in the particular influence effected by each artist on the history of art.

The organizers of this ART OF THE EYE exhibition hope that any preconceived notions or sense of irony about the limitations imposed by vision impairments will quickly give way both to a gratifying awareness that visual art is indeed the most appropriate means of sharing information about vision impairments, and a realization that there need be no limits on the creative power of the imagination.

ART OF THE EYE has been the inspiration for the first collaboration of an arts organization, FORECAST Public Artspace Productions; a museum, Minnesota Museum of Art; and a social service agency, MSB. With major support from IDS Financial Services Inc. in Minneapolis and the American Express Foundation, ART OF THE EYE has brought together disparate factions in the population—vision-impaired and normal-sighted, doctors and artists, social workers and arts administrators—and formed a new network with an unprecedented focus on art. Thus, in addition to its primary purpose of imparting information about vision and vision impairments, ART OF THE EYE should fulfill two other important objectives: to give vision-impaired artists an opportunity to exhibit new works in an environment unencumbered by the usual condescending attitudes and assumptions and to serve as a model for individuals and groups with disabilities and demonstrate how they can use the arts as a means of acquiring and sharing information about any kind of disability.

ART OF THE EYE organizers are currently seeking additional support to assist in a national tour of the exhibition. For more information about this major travelling exhibit, please call or write to FORECAST: (612)721-4394; 2955 Bloomington, Minneapolis, Minnesota 55407.



CHICAGO CONFERENCE ON FLEXNER AND THE 1990s

A special conference entitled "Flexner and the 1990s: Medical Education in the 20th Century" was held June 10 and 11 at the University of Illinois' Chicago campus. Conferees included historians, sociologists, medical educators, administrators and department heads throughout the country, who gathered to discuss a myriad of issues related to the development of medical education in the United States. On the first day, lecturers spoke on such topics as "Abraham Flexner in Historical Perspective," "Flexner and the Black Medical Schools," and "Clinical Education After Flexner," underscoring the importance of Flexner's 1910 report and yet putting it in perspective. The second day's session focused on the future of medical education and addressed obstacles to change in the area of medical education today.

The conference was sponsored jointly by the American Medical Association and the University of Illinois at Chicago, Center for Educational Development of the College of Medicine.

NEW ARCHIVES OPENS AT AMERICAN COLLEGE OF RADIOLOGY

In the 1950s a group of American radiological pioneers became concerned with the rapidly disappearing history of their chosen field. Calling themselves the "Gas Tube Gang," and informally led by Dr. Erwin Ernst, this group began to collect items relevant to the discovery of the X-ray and radium, to the development of radiology and its equipment, and to the public image of the profession. The resulting collection is the Archives of the American Institute of Radiology, housed today in the American College of Radiology building in Reston, Virginia. The Archives holdings

range from valuable autograph groupings to personal memoirs, meeting memorabilia, medals and awards, professional papers, radiographs, and a wealth of photographic and illustrative materials. Work is currently underway to catalog the nearly 200,000 photographs, slides and images in the E.R.N. Grigg Collection of radiological history.

Inquiries on this extensive collection may be addressed to Archivist Nancy Knight at (703) 648-8900.

JOHNS HOPKINS RECEIVES GRANT FOR RECORD PROJECT

The Alan Mason Chesney Archives of the Johns Hopkins Medical Institution recently was the recipient of a major grant from the National Historical Publications and Records Commission for a three-year project to study the contemporary records of the Johns Hopkins Medical Institutions. Issues to be examined include retention periods, diversity of format, storage methods, confidentiality, and historical value of medical records. Surveys will be taken of records of the Johns Hopkins Hospital, School of Nursing, School of Medicine, and School of Public Health, as well as a special study of major teaching hospitals in the United States to determine current policies in the management of medical records. A primary project goal is to publish a set of guidelines for establishing records management programs in medical institutions and possibly a published report on administering a cooperatively run records management program.

For further details, contact Nancy McCall, Assistant Archivist, at (301) 955-3043.

NEW VOLUME ON DANIEL DRAKE COMMEMORATES BIRTH OF A PIONEER PHYSICIAN

Daniel Drake, M.D., Frontiersman of the Mind is the title of a new book published by Crossroads Books of Cincinnati for the History of Health Sciences Library and Museum at the University of Cincinnati. The volume includes three heretofore unpublished addresses by one of America's most important pioneer physicians: an 1827 lecture at the Medical Department of Transylvania University in Lexington, Kentucky; an 1835 lecture to the Medical Department of the Cincinnati College; and an 1840 lecture at the Louisville Medical Institute in Louisville, Kentucky. These three addresses are part of the extensive collection on Daniel Drake at the History of the Health Sciences Library and Museum. The book also features a new biographical sketch describing Drake's varied career, as well as information on the controversies that surrounded him.

Contact Director Billie Broadus at (513) 872-5120 for further information and special prices.

SMITHSONIAN OFFERS WORKSHOP SERIES

The Office of Museum Programs at the Smithsonian Institution has published the schedule for its new series of museum professional development workshops to be held from June, 1986 to October, 1987. Those museum employees interested in "improving professional skills and practices" can benefit from a surprisingly large selection of topics during the intensive two-day workshops.

Below is a listing of the topics scheduled for 1986.

June 18-20	The Words You Exhibit
July 7-11	Principles of Conservation and Preventive Care
July 21-23	The Museum as a Learning Resource: Turning Museums Inside Out
August 4-6	Families in Museums
August 18-22	Orientation to Museum Work for Entering Professionals
August 27-28	Management of Volunteer Programs
September 8-12	Museum Archives
September 17-19	Participatory Exhibitions: Development, Management, and Maintenance of a Discovery Room
September 29-October 1	Public Programs
October 6-10	Developing, Managing, and Maintaining Collections
November 3-5	Getting the Word Out: Museum Public Relations
November 12-14	Photographic Methods for Museum Personnel
November 17-20	Museum Security: Protecting Cultural Property
December 1-5	Introduction to Museum Management
December 15-17	Current Trends: Audiovisuals in Museums

Museum professionals who wish to take advantage of this worthwhile series are invited to submit letters listing their museum experience, present responsibilities, type and size of the institution for which they work, size of department and annual budget, and their reasons for wishing to attend the workshop.

All correspondence should be sent to: Workshop Series, Office of Museum Programs, Arts and Industries Building, Room 2235, Smithsonian Institution, Washington, D.C. 20560. Calls can be taken by the Workshop Coordinator at (202) 357-3101.

NEW EXHIBITS

IMMIGRANT HEALTH CARE IN NEW YORK CITY

A comprehensive exhibit detailing the history of health care in New York's immigrant community from 1886 to 1917 is on display at the New York Academy of Medicine. From 1892 to 1954 more than 17,000,000 immigrants entered the U.S. through Ellis Island, a fact which all the more illustrates the position of New York as the portal to the New World. The exhibit examines such topics as the fate of steerage passengers on Ellis Island as they were subject to health inspections, the "Typhus Ward" of the lower east side of the city (known for inhabitants numbering 522 per acre), and abominable working conditions in unhealthy factories. After the cholera scare of 1892, New York officials established the world's first city health laboratory, a development which paved the way for many needed reforms.

This exhibit, which is the work of Historian and Archivist Dorothy Levenson, is available on loan. For further information, contact the Academy's Office of Medical Education at (212) 876-8200, ext. 230.

BAKER-CEDERBERG MUSEUM AND ARCHIVES AT ROCHESTER GENERAL HOSPITAL

Participants at the annual history of medicine conference in Rochester, New York who took the time to visit the Baker-Cederberg Museum and Archives at Rochester General Hospital were pleasantly surprised with the quality of the hospital's collection and memorabilia. The hospital has a well-deserved reputation as an innovator in the fields of radiology, laser surgery and medical education. Special thanks are due to Archivist Phil Maples, who took time from a very hectic schedule

during the Rochester meetings to personally escort interested librarians, curators and history of medicine buffs through the collection.

TURN-OF-THE-CENTURY DENTIST'S OFFICE ON EXHIBIT IN CHICAGO

Chicago's Museum of Science and Industry recently added a dental office with turn-of-the-century equipment and furnishings to its major exhibit on "Yesterday's Main Street." Illustrating procedures and implements used by dentists during the period, the office includes a display of instruments, furniture, and assorted devices on loan from Dr. and Mrs. Samuel S. Wexler of Chicago. Highlights include a 1912 Fisher open tube x-ray machine, a 1899 Weber cuspidor with ruby glass bowl, and a 1905 Dunn light, the first spotlight to be used in dentistry.

For further details, contact Irving Paley at (312) 684-1414.

NEW PERMANENT EXHIBITS AT CLEVELAND HEALTH EDUCATION MUSEUM

"The Story of Blood" is the title of an ongoing exhibit at the Cleveland Health Education Museum. This particular exhibit explores the many facets of blood and blood giving, from the cellular components to the ways in which the American Red Cross processes blood donations. Pertinent topics also include additional information on the subject of AIDS and blood transfusions. This exhibit is sponsored jointly by the Museum and the American Red Cross of Cleveland.

During the month of July, the museum will also feature the accomplishments of George Crile, M.D., founder of the Cleveland Museum of Natural History and the Cleveland Clinic Foundation. This "Frontiers in Medicine" exhibit shows Crile's skills as naturalist, artist/sculptor, physician and civic leader. It includes a premiere showing of important models Crile collected from early expeditions in Africa.

For further information, call Gail Takacs at (216) 231-5010.

"CURANDERISMO: A FOLK WAY OF HEALING"

Yet another traveling exhibit is available from the University of Texas Health Science Center at the San Antonio Library, this time featuring Mexican American folk remedies, or "Curanderismo." Included in the exhibit are glass display jars and herbs frequently used in healing, materials used in folk rituals, and colorful text panels describing the intriguing practices used by Mexican Americans to heal themselves.

For additional information on this exhibit, contact Joyce Ray, Curator of Historical Collections, at (512) 691-6271.

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